

## PATENT SPECIFICATION

NO DRAWINGS

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## COMPLETE SPECIFICATION

## Detergent Compositions

- We, PROCTER & GAMBLE LIMITED, a British Company, of Hedley House, Gosforth, Newcastle upon Tyne 3, England (formerly Thomas Hedley & Co. Ltd., of Phoenix Buildings, Collingwood Street, Newcastle upon Tyne 1), do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—
- The invention relates to detergent compositions containing complexes of cationic and anionic surface active agents.
- It is known that complexes of anionic and cationic detergents can be prepared, and a number have been prepared by mutual precipitation of anionic and cationic detergents from aqueous solution. Hitherto, it has been believed that such complexes are insoluble in water and when attempts have previously been made to include them in detergent compositions special precautions have been taken to prevent the precipitation of the complex. Such precautions have comprised including large proportions of nonionic surface active agents in the compositions or special pretreatment of the cationic detergent before mixing it with the anionic detergent.
- It has now surprisingly been found that by appropriate selection of the cationic and anionic components, not only can new complexes be produced which are soluble in water to a sufficient extent to serve as detergents but also those complexes have outstanding properties, particularly in respect of foaming power and also in respect of their ability to disperse insoluble soaps which result from the reaction of conventional soaps with the hardness constituents of hard water.
- According to the invention there is provided a detergent composition comprising a complex of, as cationic component, a cationic surface active agent which is an alkyl trimethylammonium salt in which the alkyl radical has from 4 to 16 carbon atoms and, as anionic component, an anionic surface active agent which has in its molecule an alkyl radical of from 4 to 16 carbon atoms or an aliphatic acyl radical of from 4 to 16 carbon atoms, the cationic component and the anionic component being such that the combined total of the carbon atoms in the said alkyl radical of one molecule of the cationic component and the said alkyl or aliphatic acyl radical of one molecule of the anionic component is from 18 to 22. A combined total of 20 is usually preferred.
- The complex may be preformed or it may be produced *in situ* from a mixture of the cationic and anionic components.
- The cationic-anionic complexes of the invention may form the whole detergent composition or they may of course be combined with other usual constituents of detergent compositions.
- Suitable anionic surface active agents for use as the anionic component of the complex include alkyl sulphates, alkyl sulphonates and alkylbenzene sulphonates in which the alkyl group has from 4 to 16 carbon atoms, N-acyl-N-methyl taurates in which the acyl group has from 4 to 16 carbon atoms and soluble salts of fatty acids containing from 4 to 16 carbon atoms.
- Specific examples of the complexes of this invention are hexadecyl trimethyl ammonium butyl sulphate, dodecyl trimethyl ammonium octyl sulphate, decyl trimethyl ammonium decyl sulphate, octyl trimethyl ammonium dodecyl sulphate, hexyl trimethyl ammonium myristyl sulphate, and tetradecyl trimethyl ammonium hexyl sulphate.
- In forming the complexes for use in the compositions of the invention, the individual components are chosen so that the combined total of the carbon atoms is from 18 to 22 (as stated above). Thus the following pairs of cationic and anionic compounds may be combined in equimolecular proportions:

- N-hexadecyl trimethyl ammonium bromide and sodium butyl sulphate; 20  
 N-dodecyl trimethyl ammonium bromide and sodium octyl sulphate; 25  
 5 N-decyl trimethyl ammonium bromide and sodium decyl sulphate; 25  
 N-octyl trimethyl ammonium bromide and sodium dodecyl sulphate; 30  
 10 N-hexyl trimethyl ammonium bromide and sodium tetradecyl sulphate. 35
- Table I shows the foaming power, under load, of various complexes of N-alkyl trimethyl ammonium bromides and sodium alkyl sulphates.
- 15 The foaming power under load is determined as follows:  
 100 ml. of 2° hard water at 120°F., containing 0.05% by weight of the cationic-anionic complex, are placed in a 500 ml. graduated cylinder which is then closed with a glass stopper. The cylinder is inverted 10 times and the initial suds volume is read (i.e. total volume of foam and liquid), 0.25 ml. of a fatty soil (plastic vegetable shortening) is added to the cylinder from a "Vandermic" nylon syringe. The cylinder is again inverted 10 times and the total suds volume read. This operation is repeated until a total of 1 ml. of fatty soil has been added. The contents of the cylinder are maintained at 120°F. by immersing the lower part of the cylinder (except during the actual inversions) in a constant temperature bath at 120° F.
- The "suds volume under load" is determined by adding the 5 readings, dividing the total by 5 and then subtracting 100 ml.

TABLE I

Components of Complex		Total number of carbon atoms in long chain	Suds Volume under load
Cationic	Anionic		
Hexadecyl trimethyl ammonium bromide	Sodium butyl sulphate	20	156 ml.
"	hexyl "	22	54
"	octyl "	24	16
"	decyl "	26	14
Tetradecyl trimethyl ammonium bromide	butyl "	18	62
"	hexyl "	20	204
"	octyl "	22	30
"	decyl "	24	22
Dodecyl trimethyl ammonium bromide	hexyl "	18	25
"	octyl "	20	165
"	decyl "	22	29
"	dodecyl "	24	17
Decyl trimethyl ammonium bromide	octyl "	18	35
"	decyl "	20	186
"	dodecyl "	22	44
"	tetradecyl "	24	5

TABLE I—continued

Components of Complex		Total number of carbon atoms in long chain	Suds Volume under load
Cationic	Anionic		
Octyl trimethyl ammonium bromide	sodium octyl sulphate	16	5
"	decyl "	18	70
"	dodecyl "	20	200
"	tetradecyl "	22	25
Hexyl trimethyl ammonium bromide	decyl "	16	5
"	dodecyl "	18	84
"	tetradecyl "	20	45
"	hexadecyl "	22	14

Table I shows that in general, in the cases of complexes in which the total number of carbon atoms in the long chain alkyl groups of the cationic and anionic components is 20, the foaming power is very much higher than in the cases of other complexes. There is only one exception in the case of N-hexyl trimethyl ammonium bromide with sodium alkyl sulphates and in this case the maximum foaming power is obtained with a total of 18 carbon atoms in the long chain alkyl groups of the components.

The cationic-anionic complexes of the invention may be used as the sole detergent in detergent compositions, particularly for dishwashing.

The complexes of the invention may also be used in combination with anionic synthetic detergents. In such cases the composition may conveniently be prepared by mixing the anionic synthetic detergent with less than an equimolecular proportion of the cationic surface active agent.

Thus a mixture of 80% by weight sodium dodecyl sulphate and 20% by weight N-octyl trimethyl ammonium bromide has been found to be even more effective as a dishwashing agent than the equimolecular mixture of the two components.

The cationic-anionic complexes of the invention have also been found to possess remarkable properties of lime scum dispersion when used with soap compositions particularly in toilet soaps.

The following Examples illustrate the invention.

#### EXAMPLE 1.

A highly effective dishwashing composition which has abundant and persistent foam in use has the following composition.

30%	by weight decyl trimethyl ammonium decyl sulphate
0.5%	by weight disodium hydrogen phosphate
15%	by weight industrial methylated spirit
54.5%	by weight water.

#### EXAMPLE 2.

A toilet soap is prepared to the following composition.

75%	by weight sodium soap (50% tallow: 50% coconut oil)
12%	by weight N-hexadecyl trimethyl ammonium butyl sulphate
4%	by weight lauric acid
3%	by weight electrolyte
6%	by weight water

Bars having this composition are found to be superior to a conventional toilet soap in lathering and cleansing properties and very much better in respect of the amount of lime

scum which forms when the bar is used in hard water.

The detergent compositions according to the invention may additionally contain any of the auxiliary ingredients which are normally included in detergent compositions. Thus they may contain builders such as alkali metal phosphates, polyphosphates, carbonate, silicates or sulphates. They may also contain soil-suspending agents such as carboxymethyl cellulose, and other ingredients such as tarnish inhibitors, optical bleaching agents, colouring agents and perfumes.

#### WHAT WE CLAIM IS:—

1. A detergent composition comprising a complex of, as cationic component, a cationic surface active agent which is an alkyl trimethylammonium salt in which the alkyl radical has from 4 to 16 carbon atoms and, as anionic component, an anionic surface active agent which has in its molecule an alkyl radical of from 4 to 16 carbon atoms or an aliphatic acyl radical of from 4 to 16 carbon atoms, the said cationic and anionic components of the complex being such that the combined total number of carbon atoms in the said alkyl radical of one molecule of the cationic component and the said alkyl or aliphatic acyl radical of one molecule of the anionic component is from 18 to 22.
2. A detergent composition according to claim 1 in which the said combined total number of carbon atoms is 20.
3. A detergent composition according to claim 1 or 2 in which the anionic component is selected from the group consisting of alkyl sulphates, alkyl sulphonates and alkyl benzene sulphonates in which the alkyl group has from 4 to 16 carbon atoms, N-acyl-N-methyl taurates in which the acyl group has from 4 to 16 carbon atoms and soluble soaps of fatty acids containing from 4 to 16 carbon atoms.
4. A detergent composition according to claim 3 in which the complex is hexadecyl trimethylammonium butyl sulphate.
5. A detergent composition according to claim 3 in which the complex is tetradecyl trimethylammonium hexyl sulphate.
6. A detergent composition according to claim 3 in which the complex is dodecyl trimethylammonium octyl sulphate.
7. A detergent composition according to claim 3 in which the complex is decyl trimethylammonium decyl sulphate.
8. A detergent composition according to claim 3 in which the complex is octyl trimethylammonium dodecyl sulphate.
9. A detergent composition according to claim 3 in which the complex is hexyl trimethylammonium myristyl sulphate.
10. A detergent composition according to any of the preceding claims which comprises, in addition to the cationic-anionic complex, an anionic detergent.

11. A detergent composition according to claim 10 which comprises a mixture of sodium dodecyl sulphate and octyl trimethylammonium bromide in the weight ratio 4:1. as hereinbefore described in either of the Examples. 10
- 5 12. A detergent composition according to claim 10 in which the additional anionic detergent is soap.
13. A detergent composition substantially

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